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PATENT #12
Attorney Reference Number 3382-51036 Douglas 8/21/02

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Response Under 37 C.F.R. 1.116 Expedited Procedure

In re application of: Lin et al.

Application No. 09/201,278

Filed: November 30, 1998

For: EFFICIENT MOTION VECTOR CODING FOR VIDEO COMPRESSION

Examiner: Vu Le

Date: August 9, 2002

Art Unit: 2613

CERTIFICATE OF MAILING

I hereby certify that this paper and the documents referred to as being attached or enclosed herewith are being deposited with the United States Postal Service on August 9, 2002 as First Class Mail in an envelope addressed to: Box AF, COMMISSIONER FOR PATENTS, WASHINGTON, D.C. 20231.

Kyle B. Rinehart
Attorney for Applicant

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Enclosed is an Amendment for the above application. The fee has been calculated as shown below.

CLAIMS AS AMENDED					
For	No. after amendment	No. paid for previously		Present Extra	Rate	Fee
Total Claims	20	- 20*	=	0	$18.00	$ 0.00
Indep. Claims	8	8**	=	0	$84.00	$ 0.00
Mult. Dep. Claims Fee (if not previously paid)					$280.00	
One-month Extension of Time					$110.00	
Two-month Extension of Time					$400.00	$400.00
Three-month Extension of Time					$920.00	
TOTAL ADDITIONAL FEE FOR THIS AMENDMENT						$400.00

* greater of twenty or number for which fee has been paid.
** greater of three or number for which fee has been paid.

☒ Applicants petition for an extension of time for the number of months indicated above. If an additional extension of time is required please consider this a petition therefor.

08/15/2002 AWONDAF1 00000017 09201278
01 FC:116 400.00 OP

☒ A check in the amount of $400.00 is attached.

☒ Please charge any additional fees that may be required in connection with filing this amendment and any extension of time, or credit any overpayment, to Deposit Account No. 02-4550. A copy of this sheet is enclosed.

☒ Please return the enclosed postcard to confirm that the items listed above have been received.

Respectfully submitted,

KLARQUIST SPARKMAN, LLP

By _____
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cc: Patent Group Docketing (81308.1)
Docketing

COPY OF PAPERS ORIGINALLY FILED

13/ J. Douglas 8/21/02

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Kyle B. Rinehart
Attorney for Applicant

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RESPONSE AFTER FINAL

Claims 1, 3-13 and 15-22 are pending in the application.

Claims 1, 3, 4, 7-9, 11-13, 15-19 and 20-22 were rejected under 35 U.S.C. § 102(b) as being anticipated by Yu et al., "Two-Dimensional Motion Vector Coding for Low Bitrate Videophone Applications" ("Yu"). Claims 5, 6 and 10 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Yu.

1) **The Yu reference**

Yu describes jointly coding horizontal and vertical differential motion vector ("DMV") components. [*See* Yu at page 414.] Yu describes the range of possible DMV values (in half-pixel steps) as being greater than or equal to -31.5 pixels, and less than or equal to 31.5 pixels. [*See* Yu at page 415.] Yu places all possible DMV values in a square reaching from -31.5 to 31.5 on both the x and y axis. [*See* Yu at page 415.] The square is divided into three regions: Region A is the square reaching from -8 to 8 on both the x and y axis; Region B is the square reaching from -16 to 15.5 on the x and y axis, minus the area of Region A; Region C covers the remainder of the area. [*See* Yu at page 415.]

Yu uses a variable length code table that assumes, before training, that each and every DMV pair in Region A is more likely to occur than any DMV pair in Regions B or C. "Most DMVs fall

into [Region A] because the frequency of occurrence for small DMVs is very high." [*See* Yu at page 415.] So, a variable length code table consisting of variable length codes ("VLCs" or "codes") for pairs of x and y components in Region A is generated. [*See* Yu at page 415.] The table contains 290 codes representing each of the possible pairs of absolute DMV values from 0 to 8 in Region A, in half-pixel steps (17 half-pixel steps x 17 half-pixel steps + 1 escape code) (sign bits are also used for non-zero DMV values). [*See* Yu at page 415.] The escape code is used to encode DMV values in Region B. [*See* Yu at pages 415-16.] DMV values in Region C share the same codes with DMV values in Region A or B, but incorporate an offset of ±32.0 pixels to distinguish the Region C code from the Region A or B code. [*See* Yu at page 416.] For the pre-determined DMV pairs to be represented in the VLC table (i.e., the DMV pairs of region A), Yu then determines the VLCs to be assigned to the DMV pairs, respectively. To do this, Yu creates a histogram of frequencies of occurrence for DMV pairs in a training set of five test video sequences. After "smoothing" the histogram, Yu generates the VLCs for the DMV pairs in Region A.

In other words, Yu describes, for a pre-determined set (Region A) of DMV pairs, calculating VLCs based upon frequencies of occurrence in a training set of test sequences (as adjusted by smoothing). Yu uses the "training set" to determine the relative lengths of the VLCs for the DMV pairs in the VLC table, not to select the DMV pairs for the VLC table.

2) Yu fails to teach or suggest at least one element of each of claims 1, 7, 11, 13, 16, 19, 20 and 22.

Previously, claims 1, 7, 11, 13, 16, 19, 20 and 22 were rejected as being anticipated by Yu under 35 U.S.C. § 102(b). Yu fails to teach or suggest at least one element of each of claims 1, 7, 11, 13, 16, 19, 20 and 22.

a) Yu fails to teach or suggest "wherein training determines which joint x and y motion vector components to represent in the set of available variable length codes" as recited in claim 16.

Claim 16 recites "wherein training determines which joint x and y motion vector components to represent in the set of available variable length codes." According to claim 16, x and y motion vector components are computed for a block. The x and y motion vector components are formed into a joint parameter representing joint x and y motion vector components. A single variable length code is assigned to the joint x and y motion vector components. The single variable length code is selected from a set of available variable length codes, such that shorter variable length codes are

assigned to joint motion vector components that have a higher probability of occurrence in the video images. Longer variable length codes are assigned to joint differential motion vector components that have a lower probability of occurrence. Training determines *which joint x and y motion vector components to represent in the set of available variable length codes.*

Conversely, the DMV pairs represented in Yu's VLC table are determined *before conducting any statistical analysis or training* to calculate the VLCs for the respective DMV pairs. Yu states at page 415, "A VLC table that consists of codes for 2-dim (|DMVx|, |DMVy|) entries is first generated." The training set is then used, and "resulting codeword lengths range from 2 to 13 bits." [*See* Yu at page 417.] While Yu may use training to determine the lengths of codes for DMV pairs in Region A, Yu determines which DMV pairs are to be included in its VLC table before the training is performed. Yu *assumes* (wrongly, in some cases) that each and every DMV pair in Region A is more likely to occur than any DMV pair in Regions B or C. Therefore, Yu does not teach or suggest "wherein training determines which joint x and y motion vector components to represent in the set of available variable length codes" as recited in claim 16.

Suppose a video coder is used to compress video sequences where left to right and right to left camera "panning" motion is common (i.e., motion having small or no absolute value along the y axis). Using Yu's VLC table predetermined DMV pairs, the coder would code a first DMV of (2, 7) (horizontal DMV = 2, vertical DMV = 7) with a VLC of between 2 and 13 bits. It would code a second DMV of (9.5, 0) with a 13 bit escape code and an additional 12 bits, for a total of 25 bits [*see* Yu at p. 416 (Case 2) and p. 417], even if the second DMV was more common than the first DMV. The second DMV would fall outside of Yu's Region A, and would therefore not be included in Yu's VLC table with pre-determined VLC pairs.

In contrast, training to determine *which joint x and y motion vector components to represent* in the set of available VLCs would efficiently account for cases involving DMVs such as the two described above, and properly represent the second DMV of (9.5, 0) in the set of available VLCs. For example, the Application shows an exemplary Huffman coding table trained for "general video applications" where the DMV of (2, 7) is not included, while the DMV of (9.5, 0) appears at index 109. [*See* Application at page 30.] Representing the DMV of (9.5, 0) in the set of available VLCs and, conversely, not representing the DMV of (2,7) in the set of available VLCs allows the DMVs to be coded more efficiently for general video applications.

Thus, Yu does not teach or suggest "wherein training determines which joint x and y motion vector components to represent in the set of available variable length codes" as recited in claim 16.

Claim 16 is allowable. As a result, the separate patentability of dependent claims 17 and 18 need not be addressed at this point. Claims 16-18 are allowable. Such action is respectfully requested.

b) Yu fails to teach or suggest at least one element of each of claims 1, 7, 11, 13, 19, 20 and 22.

Claim 1 recites:

> the table includes the most probable pairs of joint differential motion vector components as computed by statistical analysis of example video sequences.

Claim 7 recites:

> wherein training determines which x and y components to include in the entropy codebook.

Claim 11 recites:

> wherein statistical analysis indicates which differential motion vector components to represent with variable length codes and which differential motion vector components to represent with an escape code followed by fixed length codes.

Claim 13 recites:

> wherein training determines which joint differential motion vector components to include in the table and which joint differential motion vector components to exclude from the table.

Claim 19 recites:

> wherein the Huffman table includes variable length codes for the most probable joint differential x and y components as computed by statistical analysis of example video sequences.

Claim 20 recites:

> wherein training determines which joint x and y motion vector components to represent in the set of available variable length codes.

Claim 22 recites:

> wherein the Huffman table includes variable length codes for the most probable joint differential x and y components as computed by statistical analysis of example video sequences.

As explained above, Yu's method of creating a VLC table for DMV pairs *assumes* that each and every DMV pair in Region A is more likely to occur than any DMV pair in Regions B or C. The DMV pairs represented in Yu's VLC table are determined *before* generating VLCs for the respective DMV pairs based upon evaluation of a training set of test sequences. In Yu, statistical

analysis is done to determine VLCs for the *already selected* DMV pairs. Thus, Yu does not teach or suggest the above-cited language from each of claims 1, 7, 11, 13, 19, 20 and 22, respectively.

Claims 1, 7, 11, 13, 19, 20 and 22 are allowable. As a result, the separate patentability of dependent claims 3-6, 8-10, 12, 15 and 21 need not be addressed at this point. Claims 1, 3-13, 15 and 19-22 are allowable. Such action is respectfully requested.

CONCLUSION

The claims in their present form should now be allowable. Such action is respectfully requested.

REQUEST FOR INTERVIEW

If the Examiner finds that the amendment does not make the application allowable, the Examiner is formally requested to contact the undersigned attorney at (503) 226-7391 prior to issuance of the next communication in order to arrange a telephonic interview. It is believed that a brief discussion of the merits of the present application will allow the application to be passed to issue. Applicant submits the foregoing remarks so that the Examiner may fully evaluate Applicant's position, thereby enabling the interview to be more productive.

This request is being submitted under MPEP § 713.01, which indicates that an interview may be arranged in advance by a written request.

Respectfully submitted,

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